Final Year Project Proposal Form

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| Programme | | MEng(Hons) Robotics Engineering |
| Module Code | | PROJ324 |
| Proposer | | **Self** / ~~Supervisor~~ / ~~Industry~~ |
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| Proposal Title | | Open-water Rubbish Collection robot with Automatic sensing (O.R.C.A) |
| **Objective:**  Create a surface-litter cleaning robot for still and slow-moving expanses of water such as a canal, lake, or harbour. The objective of this project is to create cleaner and safer environments on still bodies of water that typically collect large amounts of surface-dwelling litter. The robot will traverse its environment autonomously until it has filled its litter storage, or the battery is running flat, at which point it will return to a designated location to be collected and offload relevant telemetry data. | | |
| **Aim:**  Pollution has become an increasingly pressing issue especially in large bodies of water such as harbours, canals, lakes, and reservoirs. It is difficult to remove litter from the surface of water for many reasons. Litter drifts around in the body of water due to the currents and water flow in these bodies of water and usually requires manual removal by an individual in the water.  This project aims to provide a solution to automate the collection of this litter from the surface of inland bodies of water. This will be done using a form of boat/raft that will be able to traverse the environment safety and effectively and will be able to filter the litter from the water.  One of the main inspirations for this project is the WasteShark ([source](https://www.ranmarine.io/products/wasteshark/)) which is designed to remove floating pollution on the surface from lakes, ponds, waterways, and harbours. It should be able to remove plastics, algae, and accumulated biomass.  This project contains both software and hardware.  Hardware:   * The main body of the craft that will be collecting the litter. * Suitable propulsion method for driving the craft around (ie. Propellors, Fans, Jets etc.). This will be important and will need to be considered for the type of environment that the craft will be going into. * Collection system for the rubbish to remove it from the surface of the water. * Make custom remote controllers that can communicate together to tell the operator important information about the craft.   Software:   * Implement a suitable control system to allow movement of the craft and control the collection of the rubbish. * Automatically sense when the rubbish collection is full and alert the user accordingly. * Automatically sense when the battery is below a certain limit, in both the controller and receiver. * Suitable communication between the host device and the controller, relaying data such as battery voltage, how full the storage container, time of current usage, speed. * A system to track the amount of rubbish collected along with other important types of information such as duration of task. * Further extended deliverable – Implement machine vision to identify and track rubbish on the surface of the water, manoeuvre to it and automatically begin collecting rubbish.   The scope of this project has many different elements, and these can be split into different assessable levels.   1. Design and create a boat that is capable of floating on water and being driven around by a radio controller and receiver. The craft will need to be an appropriate size such that it can carry all the equipment on board as well as a decent payload of rubbish to be collected. I will need to create a suitable propulsion system, steering system, and make sure the craft is stable both at top speed and when cornering. It is important to make sure the craft is highly controllable and safe to operate. 2. Design and create a suitable litter collection system that can collect litter on the surface of water. The system will need to be able to be turned off, not be damaging to wildlife, and be able to collect all types of litter that collect on the surface. 3. Combine the litter collection system with the main hull of the boat. Check that the functionality of both components is not impeded by the combination of the two parts together. Get the two parts of the boat controlled separately using a radio controller (as the radio controller that I have is only 3 channels). 4. Implement a custom microcontroller based remote control and receiver for the boat that would allow broader uses for the controller. The controller would be able to display some rudimentary values such as, battery charge on the boat, the current capacity of the rubbish collection system, and the status of the litter collection system (operating/not operating). 5. Add sensors, both active and passive to test for current capacity of the litter collection basket as well as current battery charge. The status of these combined would be these combined sensors would be outputted to the controller that would alert the user, alongside stopping the boat when the power is low or when the litter collection basket is full.   Successful tests of the system will be:   * The boat floats and can be controlled safely. * The boat can carry a sufficient payload to allow it to collect and store litter as it is being driven around. * The litter collection system successfully collects litter and stores it without missing or dropping anything back into the water. * The litter collection system doesn’t cause any harm to the environment unless it is collecting wildlife that is actively harming the environment, such as algal blooms that use up all the oxygen in the water at night and can cause suffocation of fish and other marine life. * The boat and litter system work together without impeding on their respective roles and functions. * The controller allows effective controlled movement of the craft as well as effective litter collection. * The Sensors on the boat can detect when the litter collection tray is filled and when the battery is running low and, alert the user to this.   Future Developments  If this project was to be taken on further to Masters level further enhancements in autonomy and automation would need to be considered. Allowing the craft to automatically map out it’s environment and to track litter on the surface of the water would be the next viable step for this project. This would incorporate some form of autonomous mapping device, such as a lidar and/or GPS system, along with a computer vision pipeline to allow for autonomous tracking of the litter. Using the environment tracking, the craft could be made to return to its home position when the battery is running low or when the litter collection basket is full. The status and current capacity of the craft could be tracked in real time and displayed via a web interface or similar. This would allow for real time tracking and diagnostics of the craft as it is traversing. This information could be used to calculate important information like amount of litter collected, power usage, distance cover, current run time, and more. | | |